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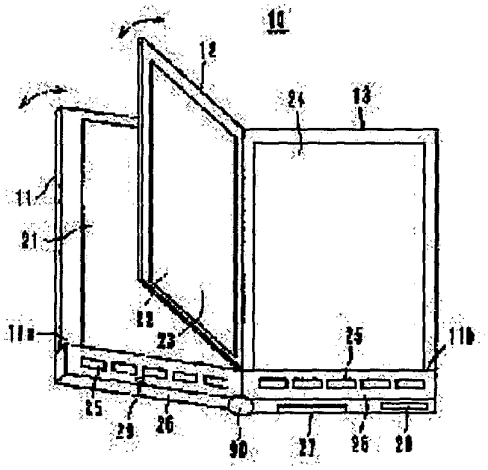
(54) DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a power-saving display device which is thin and can display many images at the same time.

SOLUTION: The liquid crystal display device 10 is constituted by binding a top cover 11, an intermediate display body 12, and a back cover 13. Memory- functional liquid crystal display elements which constitute a 1st and a 4th page are provided in the top cover 11 and back cover 13 and memory-functional liquid crystal display elements which constitute a 2nd and a 3rd page are provided on both the surfaces of the intermediate display body 12. When each page is spread, a display based upon image data transferred from external equipment is made on the spread page.



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* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
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CLAIMS

[Claim(s)]
[Claim 1] It is the display unit characterized by being the liquid crystal display object with which it had the liquid crystal display object of two or more sheets, among those at least one sheet equipped both sides with the display screen, and each aforementioned liquid crystal display object containing the display device which comes to pinch the liquid crystal layer which maintains a display state where impression of voltage is stopped between the substrates of a couple.
[Claim 2] The display unit according to claim 1 characterized by the ability of the aforementioned liquid crystal display object to equip with the main part of equipment which has a power supply section and a drive control section, and remove from the main part of equipment.
[Claim 3] The display unit according to claim 1 or 2 characterized by having the binding means filed possible [rotation of those end sections] where the liquid crystal display object of two or more aforementioned sheets is piled up, and a directions means to direct the display of a picture to the opened display screen when the aforementioned liquid crystal display object is opened.
[Claim 4] The claim 1 to which the substrate of the aforementioned liquid crystal display object is characterized by the bird clapper from a resin film, a display unit according to claim 2 or 3.
[Claim 5] The aforementioned liquid crystal layer is the claim 1 characterized by the bird clapper from the liquid crystal which shows a cholesteric phase at a room temperature, a claim 2, and a display unit according to claim 3 or 4.
[Claim 6] The aforementioned liquid crystal display object is the claim 1 characterized by carrying out the laminating of a red display device, a green display device, and the blue display device, a claim 2, a claim 3, and a display unit according to claim 4 or 5.
[Claim 7] The claim 1 characterized by having the resetting means for resetting the display of the aforementioned liquid crystal display object, a display unit according to claim 2 or 3.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to a display unit and the display unit equipped with two or more display screens in order to display information, such as a picture and a character, especially.
[0002]
[The background and technical problem] of invention Conventionally, the thing various in the display unit which displays information, such as a picture and a character, is offered. Moreover, in recent years, an information terminal unit comes to spread widely and the display unit in which many and a colorful display are possible is called for.
[0003] Then, although high-definition-izing of a screen, enlargement, thin-shape-izing, power-saving, etc. are considered, there is nothing that satisfies which conditions and it has troubles, such as causing a cost rise. moreover -- simultaneous -- many -- when it constituted so that the picture of several sheets could be displayed, it was not avoided that a display unit is enlarged
[0004] Then, the purpose of this invention is a thin shape, can display many pictures simultaneously and is to offer the display unit of power saving.
[0005]
[The composition, operation, and effect] of invention In order to attain the above purpose, the display unit concerning this invention was equipped with the liquid crystal display object of two or more sheets, and at least one of sheets of it equips both sides with the display screen. this invention is an album type display which, so to speak, has two or more display screens, and many screens can be simultaneously displayed by considering as the state where became compact and it opened wide with the thin shape with constituting the display screen from liquid crystal. Furthermore, since the liquid crystal display element of memory nature is used, power is consumed only at the write-in time of a screen, power-saving can be attained, and a display image can be maintained where a display object is removed from the main part of equipment.
[0006]
[Embodiments of the Invention] Hereafter, the operation gestalt of the display unit concerning this invention is explained with reference to an accompanying drawing.
[0007] (Refer to the outline composition of the 1st operation gestalt, drawing 1 - drawing 4) Drawing 1 shows the appearance of the album type display unit 10 which is the 1st operation gestalt of this invention. this display unit 10 -- the [the 1st display object (cover) 11, the 2nd display object (metropolitan newspaper) 12, and] -- from 3 display objects (back cover) 13 -- becoming -- the [the 1st and] -- on 3 display objects 11 and 13, the head page 21 and the last page 24 constitute as the display screen, respectively -- having -- the 2nd display object 12 -- as the display screen -- respectively -- the 2nd -- page 22 -- 23 [page / 3rd] is constituted The liquid crystal display element 100 which shows each display screen to drawing 5 is used, and mentions the composition later. Each display objects 11, 12, and 13 are filed free [rotation] in the rotation pivot 90 by each end, and the state where it closed is as being shown in drawing 2 .
[0008] the 2nd display object 12 -- the [the 1st and] -- the time of the lower part [objects / 3 display / 11 and 13] being short, and closing -- the / level difference section 11a / of the 1st display object 11 /, and / -- it is located in level difference section 11b of 3 display objects 13 the [the 1st and] -- let the lower part of 3 display objects 11 and 13 be the control unit 26 which formed the various operation keys 25 The control unit 26 of the 1st display object 11 is answered at opening and closing of liquid crystal display equipment 10, ON / electric power switch 29 to turn off is formed, and the cell hold room 27 and the memory card insertion mouth 28 are formed in the control unit 26 of the 3rd display object 13. Moreover, the control circuit shown in drawing 8 is held in the control unit 26.
[0009] Drawing 3 shows an example of a display gestalt and shows the state where 22 [page / 2nd] was opened with

the head page 21. In this example, the picture of two or more sheets is freely displayed on each pages 21 and 22 in the size or the direction. Moreover, it blows off, and alphabetic information, such as a title and an explanatory note, doubles and is displayed. Thus, if it is in this display unit 10, the attachment display of a picture and presenting of additional information are possible, for example, it is suitable also as layout equipment at the time of sticking a silver salt photograph, a clipping of a newspaper and a magazine, etc. on an album.

[0010] As an operation key attached in the control unit 26, the control method of a display that a skip key and 25c are reset keys, and a reading key and 25d used [25a and 25b] these, as for a re-write-in key and 25e is mentioned later.

[0011] Drawing 4 shows the case where the aforementioned display unit 10 is used as a sub display of the information terminal unit (personal computer) 95. It connects with a terminal unit 95 through a connection code, and if a display unit 10 transmits and receives data of each other and the image data transmitting instructions from a terminal unit 95 are received, it will rewrite the screen of a page (for example, the 1st page 21 and the 2nd page 22) opened now according to the image data transmitted.

[0012] In this case, a constant without the need of rewriting frequently, for example, a schedule table, a calender, a telephone directory, an address book, a memorandum, a map, E-mail arrival information, etc. are displayed on a display unit 10. By displaying these constants on a sub display, edit etc. can be efficiently worked now, using all the fields of the display of a terminal unit 95 effectively. In case a multi window is displayed, the non-active window which hides in the bottom of another window may be displayed, or the window closed at the end may be displayed. You may display the picture for appreciation. Anyway, since color display is possible, it is colorful and the good display of visibility is possible, so that it may mention later.

[0013] (Refer to a liquid crystal display element, drawing 5 - drawing 7) Next, the liquid crystal display element 100 included in the display unit 10 is explained with reference to drawing 5 . drawing 5 -- some aforementioned 2nd display objects 12 (the liquid crystal display element is prepared in the front rear face) -- the cross section is shown This liquid crystal display element 100 allots red display layer 111R which displays on the both sides of the optical-absorption layer 121 by switch of red selective reflection and a transparent state, carries out the laminating of the green display layer 111G which display by switch of green selective reflection and a transparent state on it, and carries out the laminating of the blue display layer 111B which displays by switch of blue selective reflection and a transparent state on it further.

[0014] G and 111B pinch the columnar structure object 115 made of a resin, liquid crystal 116, and a spacer 117 between the transparent each display layer 111R and 111 substrates 112 which formed the transparent electrode 113,114, respectively. On a transparent electrode 113,114, an insulator layer 118 and the orientation control film 119 are formed if needed. Moreover, the sealant 120 for closing liquid crystal 116 is formed in the periphery section (outside of a viewing area) of a substrate 112.

[0015] It is pulled out by the method of outside in order to connect the end of a transparent electrode 113,114 to a drive control section, respectively. Drawing 5 shows the state where the signal electrode 114 and the connection terminal area 130 are connected through the anisotropy electrical conductive gum 131. And between transparent electrodes 113,114, a predetermined pulse voltage is impressed from a drive control section, respectively. This applied voltage is answered and a display is switched between the transparent state where liquid crystal 116 penetrates the light, and the selective reflection state of reflecting the light of specific wavelength alternatively.

[0016] The transparent electrode 113,114 prepared in each display layers 111R, 111G, and 111B is made to have countered so that it may consist of two or more band electrodes which maintained the respectively detailed interval and were put in order in parallel and the sense with which the band electrode is located in a line may serve as the right-angled direction mutually. Energization is performed to the band electrode of these upper and lower sides one by one. That is, voltage is impressed one by one in the shape of a matrix to each liquid crystal 116, and a display is performed. This is called a matrix drive. A full color picture is displayed on the liquid crystal display element 100 by performing such a matrix drive sequential or simultaneous for every display layer.

[0017] In detail, with the liquid crystal display element which pinched the liquid crystal which shows a cholesteric phase, it displays with a room temperature between two substrates by switching the state of liquid crystal to a planar state and a focal conic state. If P and the average refractive index of liquid crystal are set to n for the spiral pitch of cholesteric liquid crystal when liquid crystal is in a planar state, the light of wavelength lambda=P-n will be reflected alternatively. Moreover, in the state of focal conic, when the selective reflection wavelength of cholesteric liquid crystal is in an infrared light region, it is scattered about, and in being shorter than it, it penetrates the light. Therefore, a black display is attained in the state of selective reflection color specification and focal conic in the state of a planar by setting selective reflection wavelength as a light region, and preparing an optical-absorption layer in an opposite side the observation side of an element. Moreover, by setting selective reflection wavelength as an infrared light region, and preparing an optical-absorption layer in an opposite side the observation side of an element, although the

light of the wavelength of an infrared light region is reflected in the state of a planar, since the light of the wavelength of a light region penetrates, the display of the white by dispersion is attained in the state of a black display and focal conic.

[0018] (Full color display) The liquid crystal display element 100 which carried out the laminating of each display layers 111R, 111G, and 111B can perform a red display by making blue display layer 111B and green display layer 111G into the transparent state where liquid crystal became a focal conic array, and making red display layer 111R into the selective reflection state from which liquid crystal became a planar array. Moreover, yellow can be displayed by making blue display layer 111B into the transparent state where liquid crystal became a focal conic array, and making green display layer 111G and red display layer 111R into the selective reflection state from which liquid crystal became a planar array. Similarly, red, green, blue, white, cyanogen, a Magenta, yellow, and a black display are possible by choosing a transparent state and a selective reflection state for the state of each display layer suitably. Furthermore, by choosing a middle selective reflection state as a state of each display layers 111R, 111G, and 111B, the display of neutral colors is attained and it can use as a full color display device.

[0019] About the order of a laminating of each display layers 111R, 111G, and 111B in the liquid crystal display element 100, the case except being shown in drawing 5 is also possible. However, if the direction of the light of a long wavelength field takes that permeability is high into consideration compared with a short wavelength field, since more light will penetrate [the direction which makes shorter than the selective reflection wavelength of the liquid crystal contained in a lower layer the selective reflection wavelength of the liquid crystal contained in an upper layer] to a lower layer, a bright display can be performed. Therefore, sequentially from an observation side (the direction of arrow A), blue display layer 111B, green display layer 111G, red display layer 111R, and a bird clapper are the most desirable, and display grace with this most desirable state is obtained.

[0020] (Various material of a display device) As a transparent substrate 112, a transparent and colorless glass plate and a transparent resin film can be used. As a material of a transparent resin film, a polycarbonate resin, polyether sulfone resin, polyethylene-terephthalate resin, norbornene resin, polyarylate resin, amorphous polyolefin resin, and denaturation acrylate resin etc. is mentioned. What is necessary is for there to be dimensional stability and surface smooth nature without a high translucency and an optical anisotropy, abrasion resistance, flexibility, high electric insulation, chemical resistance, mesomorphism-proof, thermal resistance, moisture resistance, gas barrier nature, etc., and just to choose what has a required property according to the environment and the use to be used as a property of a resin film.

[0021] As a transparent electrode 113,114, transparent electrodes, such as ITO (Indium Tin Oxide), are usable and can also use photoconductivity films, such as metal electrodes, such as aluminum and silicon, or an amorphous silicon, and BSO (Bismuth Silicon Oxide). Moreover, about the transparent electrode 114 of the lowest layer, black electrodes also including a role of an optical-absorption object can be used.

[0022] Organic films, such as inorganic films, such as a silicon oxide, or polyimide resin, and an epoxy resin, are used so that it may function also as a gas barrier layer, the short-circuit between substrates 112 is prevented, or an insulator layer 118 raises the reliability of liquid crystal. Moreover, as an orientation control film 119, a polyimide is typical.

[0023] As liquid crystal 116, what shows a cholesteric phase at a room temperature is desirable, and the chiral pneumatic liquid crystal obtained by adding a chiral dopant to a pneumatic liquid crystal especially is suitable.

[0024] A chiral dopant is an additive which has the operation which twists the molecule of a pneumatic liquid crystal, when added by the pneumatic liquid crystal. By adding a chiral dopant to a pneumatic liquid crystal, the spiral structure of a liquid crystal molecule which has a predetermined twist interval arises, and this shows a cholesteric phase.

[0025] By changing the addition of a chiral dopant, a chiral pneumatic liquid crystal can change the pitch of a spiral structure, and has the advantage that the selective reflection wavelength of liquid crystal is controllable by this. In addition, the "helical pitch" defined by the distance between molecules when a liquid crystal molecule generally rotates 360 degrees along with the spiral structure of a liquid crystal molecule as a term showing the pitch of the spiral structure of a liquid crystal molecule is used.

[0026] As a material used for the columnar structure object 115, thermoplastics can be used, for example. It is the material which softens by heating and is solidified by cooling, and this is expected to have not causing the liquid crystal material to be used and a chemical reaction and moderate elasticity.

[0027] As an example, a polyvinyl chloride resin, a polyvinylidene chloride resin, a polymethacrylic-acid-ester resin, a polyacrylic ester resin, a polyvinyl acetate resin, polystyrene resin, polyamide resin, a polyethylene resin, polypropylene resin, a fluororesin, a polyurethane resin, a polyacrylonitrile resin, a polyvinyl-ether resin, polyvinyl ketone resin, a polyvinyl-pyrrolidone resin, polycarbonate resin, a chlorinated-polyether resin, a saturated-polyester resin, etc. are mentioned, for example.

[0028] What is necessary is just to form the columnar structure object 115 from whether it is independent in these, and

material which is mixed or contains such one kind or mixture at least. [two or more]
[0029] As the aforementioned matter is shown in drawing 6 using the well-known printing method, it prints using a pattern so that the shape of a dot pillar may be formed. The size of a cross-section configuration, and an array pitch and configurations (the shape of a pillar and a drum, polygon, etc.) are suitably chosen by the size and pixel resolution of a liquid crystal display element. Moreover, since a numerical aperture will improve if the columnar structure object 115 is arranged preferentially between electrodes 113, it is more desirable.
[0030] The particle which consists of hard material which deforms neither by heating nor pressurization as a spacer 117 is desirable. For example, organic system composition spherical grains, such as inorganic material, such as a silica glass of the shape of a thing and a ball which turned glass fiber minutely, and alumina powder, or divinylbenzene system cross linked polymer, and polystyrene system cross linked polymer, are usable.
[0031] Thus, the hard spacer 117 which maintains the gap between two substrates 112 at a predetermined size, By forming the resin structure 115 which makes a principal component the thermoplastic polymeric materials which are arranged based on predetermined mapping rule in a viewing area, and carry out adhesion support of the substrate 112 of a couple While supporting both the substrates 112 firmly over the whole region of a substrate 112, there is no array nonuniformity and, moreover, generating of a foam can be suppressed under low-temperature environment.
[0032] (Example of manufacture of a liquid crystal display element) Here, the example of manufacture of the liquid crystal display element 100 is explained briefly. First, two or more band-like transparent electrodes are formed on two transparent substrates, respectively. After a transparent electrode forms an ITO film by the sputtering method etc. on a substrate, it performs patterning by the photolithography method and forms.
[0033] Next, a transparent insulator layer and an orientation control film are formed in the transparent-electrode forming face of each substrate. An insulator layer and an orientation control film can be formed using organic materials, such as inorganic material, such as a silicon oxide, and polyimide resin, by well-known methods, such as the sputtering method, the spin coat method, or the roll coat method, respectively.
[0034] In addition, rubbing processing is not usually performed to an orientation control film. Although work of an orientation control film still is not clear, it is thought that the achoring effect of a grade of having received the liquid crystal molecule can be given by existence of an orientation control film, and it can prevent that the property of a liquid crystal display element changes with time. Moreover, coloring matter is added to these thin films, the function as a light filter is given to them, and you may make it raise color purity and contrast to them.
[0035] In this way, while was prepared and a transparent electrode, an insulator layer, and an orientation control film form the resin structure in the electrode forming face of a substrate. After the resin structure supplies the method of breathing out and forming on a substrate resin material, such as print processes which print to the substrate which extruded the paste-like resin material which dissolved the resin in the solvent by the squeegee through the screen version, the metal mask, etc., and laid it on monotonous, and a dispenser, the ink-jet method, from the point of a nozzle, or resin material on a plate or a roller, it can form with the replica method which imprints this on a substrate front face. As for the height at the time of formation of the resin structure, it is desirable to make it larger than the thickness of a desired liquid crystal display layer.
[0036] A sealant is prepared in the electrode forming face of the substrate of another side using ultraviolet-rays hardening resin, thermosetting resin, etc. A sealant is arranged to annular [which continues in the rim section of a substrate]. What is necessary is just to perform it with the replica method imprinted on a transparent substrate, after arrangement of a sealant forms the print processes and the resin using the method of breathing out and forming resins, such as a dispenser and the ink-jet method, on a substrate from the point of a nozzle, the screen version, a metal mask, etc. on a plate or a roller like the resin structure mentioned above. Next, a spacer is conventionally sprinkled by the well-known method on the front face of one [at least] substrate.
[0037] And the substrate of these couples is piled up so that an electrode forming face may counter, and it heats, pressurizing from the both sides of this substrate pair. Pressurization and heating can be performed by passing between a roller 151 and plates 150, carrying substrate 112a by which the resin structure 115 was formed on the plate 150, and heating and pressurizing opposite substrate 112b with heating / pressurization roller 151 from an edge in piles, as shown in drawing 7 . If such a method is used, even if it uses the flexible substrate which has flexibility, such as a film substrate, a cell is producible with a sufficient precision. If the resin structure is formed by thermoplastic polymeric materials, the resin structure can be softened by heating, it can be made to be able to solidify by cooling, and both substrates can be pasted up with the resin structure. Moreover, when thermosetting resin material is used as a sealant, it is good to stiffen a sealant by heating in the case of the superposition of this substrate.
[0038] In this superposition process, liquid crystal material is dropped on one substrate, and liquid crystal material is poured into a liquid crystal device simultaneously with the superposition of a substrate. In this case, what is necessary is to include a spacer in liquid crystal material beforehand, and just to drop this at the band-electrode forming face of

one [at least] substrate.
[0039] The substrate whole region can be filled up with liquid crystal material by extending liquid crystal material to the other end, liquid crystal material being dropped at the edge of a substrate, and piling up a substrate with a roller. By carrying out like this, it can reduce involving the foam produced when piling up a substrate in liquid crystal material.
[0040] Then, since it continues pressurizing a substrate until substrate temperature falls below to the softening temperature of the resin material which constitutes the resin structure at least, pressurization is stopped, further, when photoresist material is used as a sealant, optical irradiation is performed after that and a sealant is stiffened.
[0041] In the same procedure, liquid crystal material is changed into that from which selective reflection wavelength differs, and the object for a blue display, the object for a green display, and the cell for a red display are produced. In this way, the laminating of the produced cell is carried out to three layers, and these are stuck with adhesives, and further, an optical-absorption layer is prepared in the lowest layer, and it considers as a full color liquid crystal display element.
[0042] (Refer to a control circuit, drawing 8 , and drawing 9) Next, the control circuit of the aforementioned liquid crystal display equipment 10 is explained with reference to drawing 8 . A control circuit consists of the interface 53 for which data are exchanged between a central processing unit 51, the image memory 52 which stores image data temporarily, and the memory card inserted in the external instrument and the insertion mouth 28 of the aforementioned information terminal unit 95 grade, the image processing system 54 which performs an image processing required for the image data transmitted through an interface 53, a drive control section 56 of each pages 21, 22, 23, and 24 (liquid crystal display element 100), and a power supply 59.
[0043] A central processing unit 51 is equipped with RAM57 which stores temporarily ROM58 and the various information that various control programs were memorized, and the signal from the operation key 25 is inputted through a control section 55.
[0044] The image data transmitted through an interface 53 is once memorized by the image memory 52. Based on the data accumulated at this image memory 52, the drive control section 56 drives the liquid crystal display element 100 contained in a predetermined page, and writes in a picture.
[0045] Two or more pixel composition of the liquid crystal display element 100 is expressed with the matrix of the scanning electrodes R1, R2-Rm of a book, and signal electrodes C1, C2-Cn (n and m are the natural number), respectively, as shown in drawing 9 . The scanning electrodes R1, R2-Rm are connected to the output terminal of the scanning drive IC 61, and signal electrodes C1, C2-Cn are connected to the output terminal of the signal drive IC 62.
[0046] The scanning drive IC 61 and the signal drive IC 62 are connected to the LCD controller 97 through the switching circuit 96, and the drive control section 56 is constituted by these drives 61 and ICs 62, a switching circuit 96, and the LCD controller 97. Directions are taken out to the LCD controller 97, and a central processing unit 51 makes the drive 61 and ICs 62 connected to the selected liquid crystal display element 100 control, impresses voltage one by one between each scanning electrode and a signal electrode, and writes a picture in the liquid crystal display element 100 while it chooses the liquid crystal display element 100 which controls a switching circuit 96 and is set as the object of a drive.
[0047] While the scanning drive IC 61 outputs a selection signal to a predetermined thing among the scanning electrodes R1, R2-Rm and considers as a selection state, it outputs a non-selection signal to other electrodes, and is taken as the state where it does not choose. The scanning drive IC 61 impresses a selection signal to each scanning electrodes R1, R2-Rm one by one, switching an electrode by the predetermined time interval. On the other hand, the signal drive IC 62 outputs the signal according to image data to each signal electrodes C1, C2-Cn simultaneously to rewrite each pixel on the scanning electrodes R1 and R2 in a selection state - Rm. For example, selection of the scanning electrode Ra rewrites simultaneously pixel LRa-C1 for an intersection of this scanning electrode Ra and each signal electrodes C1, C2-Cn - LRa-Cn (natural number with which a fills a<=m). The voltage difference of the scanning electrode and signal electrode in each pixel serves as rewriting voltage which is a pixel by this, and each pixel is rewritten according to this rewriting voltage.
[0048] Here, if the 1st threshold voltage for solving a twist of the liquid crystal which shows a cholesteric phase is set to Vth1 and voltage will be lowered for voltage Vth1 to the 2nd two or less threshold voltage Vth smaller than the 1st threshold voltage Vth1 after [sufficient] carrying out time impression, it will be in a planar state. moreover, two or more Vth(s) are enough in one or less-Vth voltage -- if time impression is carried out, it will be in a focal conic state After these two states stop voltage impression, they are maintained stably. Moreover, the display of halftone, i.e., a gradation display, is possible by impressing the voltage between Vth1-Vth2.
[0049] Although rewriting of each pixel can be performed by the method mentioned above, when the picture is already displayed, in order to lose the influence by this picture, it is desirable to reset the whole of each pixel in the same display state before rewriting. Reset may be performed by putting all pixels in block, and may be performed for every

scanning electrode. For example, since sufficient transparent state is acquired when resetting each pixel in the focal conic state, it has become clear that comparatively long time is required. Therefore, when all pixels are put in block in advance of rewriting and it resets in the focal conic state, as compared with the case where it resets for every scanning electrode, time of rewriting can be shortened and it is desirable.

[0050] (others -- liquid crystal display element) in addition in the aforementioned liquid crystal display element 100, the element composition in which the columnar structure object made of a resin is contained in a liquid crystal display layer was explained Enlargement is easy, and driver voltage has the feature which was excellent in various [comparatively small / that it is strong against a shock], and it is especially useful while such composition can produce the liquid crystal display element which was moreover lightly excellent in the display property using the film substrate. However, it is also possible to constitute a liquid crystal display layer as a liquid crystal bipolar membrane of the so-called macromolecule distributed type by which the memory nature liquid crystal itself was not necessarily limited to this composition, liquid crystal was distributed or the 3-dimensional network structure of a macromolecule was conventionally formed into liquid crystal into the 3-dimensional network structure of a well-known macromolecule. Moreover, although explained taking the case of the bistability nature liquid crystal which shows a cholesteric phase as liquid crystal which has memory nature, not only this but a ferroelectric liquid crystal can also be used.

[0051] (Refer to an enlarged display and drawing 10) Drawing 10 shows the method of presentation which carries out the enlarged display of the picture of one sheet using the screen of two sheets. Usually, as shown in drawing 10 (A), the 1st page of Picture A is displayed on 21, and the 2nd page of Picture B is displayed on 22. Here, as shown in drawing 10 (B), a display unit 10 is rotated 90 degrees, pages 21 and 22 are used as a screen of one sheet, and the enlarged display of the picture A is carried out. As long as it is troublesome to change equipment 10 every length, the upper and lower sides of Picture A may be cut by the image processing, and an enlarged display may be carried out over pages 21 and 22 with every width.

[0052] (Invisibility-ized control) If it is in this display unit 10, in order to hold the secret nature of a display image in consideration of the case where an operator leaves equipment 10 before temporarily etc. again, you may build a means, for example, a wallpaper display means, to invisibility-ize the display screen temporarily in a control circuit.

[0053] (Refer to a control procedure, drawing 11 - drawing 16) The control procedure which a central processing unit 51 processes in the aforementioned display unit 10 is explained hereafter.

[0054] Drawing 11 shows the main routine of a central processing unit 51. Here, based on ON of the electric power switch 29 by opening liquid crystal display equipment 10, a central processing unit 51 starts and Interior RAM, a register, etc. are initialized at Step S1. And while turning on the power supply of the drive control section 56 at Step S2, the timer for power saving is started. ON of the drive control section 56 means starting the energization to the booster circuit which specifically carries out the pressure up of the voltage supplied from a power supply, and is supplied to drive 61 and ICs 62 etc.

[0055] Next, the sub routine of Steps S3-S7 is called one by one, and required processing is performed. That is, at Step S3, reception of the data sent from the outside is processed and Step S4 detects the existence of page turning over, and the existence of opening and closing of a display. At Step S5, the existence of operation of the operation key 25 is processed, in Step S6, renewal of a screen is processed and power-saving processing which turns off the control section 56 which drives the display screen to predetermined timing in Step S7 is performed. In addition, it mentions later about these sub routines.

[0056] Next, if the existence of the end instructions (OFF of the electric power switch 29 by closing liquid crystal display equipment 10 here etc.) from a user is judged at Step S8 and there are no end instructions, it returns to Step S3, and if it is, the energization to each part connected to a central processing unit 51 at Step S9 and the energization to central processing unit 51 self will be stopped, and processing will be ended. You may control to change a central processing unit 51 into a sleep state at this time.

[0057] Drawing 12 shows the sub routine of the data reception performed at Step S3. Here, it judges first whether the data Request to Send was received from the external terminal at Step S11. A data Request to Send is transmitted from an external terminal that the window eliminated from on the main screen should be displayed on a sub display, when displaying the predetermined picture which operated for example, the external terminal and was memorized by the external terminal, such as a calender and a schedule table, on a sub display, or when it newly opens another window on the window which showed on the main screen of an external terminal or a window is closed. If this demand is received, reception of image data will be started at Step S12, the instructions which rewrite a screen in a receiving picture at Step S13 will be emitted, and this sub routine will be ended.

[0058] Drawing 13 shows the sub routine of the page recognition processing performed at Step S4. First, it judges whether there was any page turning over at Step S21. Since the display object 12 of one sheet is only installed among

covers 11 and 13, this display unit 10 will judge whether pages 21 and 22 are opened and whether pages 23 and 24 are opened. When a page is turned over, it switches to the page of the spread state after turning over from the page of the spread state before turning over the screen set as the operation object of each operation key 25 at Step S22. The switching circuit 63 mentioned above is specifically controlled, and the drive 61 and ICs 62 connected to the liquid crystal display element contained in the page used as the candidate for operation is controlled by the LCD controller 64.

[0059] On the other hand, at Step S23, if it judged and closed whether the display unit 10 was closed, it will be ordered end processing of control at Step S24, and this sub routine will be ended.

[0060] Drawing 14 shows the sub routine of the key recognition processing performed at Step S5. Here, it first judges whether either of the keys 25a, 25b, 25d, and 25e was turned on at Step S31. If neither of the keys is turned on, this sub routine is ended immediately. If one of keys was turned on, it will judge whether the key turned on at Step S32 sent, and page rise key 25a was turned on at Step S33 after the check of that them are Keys 25a and 25b (display demand of the following page picture). If it is the demand of a page rise, the instructions rewritten in the following page picture at Step S35 will be emitted after a check of that the picture displayed at Step S34 now is not the last page picture.

[0061] Moreover, if it is not ON of a page rise key (it is NO at Step S33), it will judge with page down key 25b having been turned on (display demand of the last page picture), and the instructions rewritten in the last page picture at Step S37 will be emitted after a check of that the picture displayed at Step S36 now is not a head page picture.

[0062] If it judges with on the other hand reset key 25e for eliminating a screen at Step S38 having been turned on, it will rewrite in order to reset a screen at Step S39, and instructions will be emitted. If it is not ON of reset key 25e (it is NO at Step S38), it will judge with re-write-in key 25d having been turned on, and the rewriting instructions for writing in the same picture again at Step S40 will be emitted.

[0063] Drawing 15 shows the sub routine of the screen update process performed at Step S6. Here, it judges first whether the drive control section 56 of the display screen is an ON state at Step S52 after a check of that screen rewriting instructions are taken out with Step S51. If it is an ON state, it will shift to Step S55, and if it is an OFF state, after turning on the drive control section 56 at Step S53 and starting the timer for power saving at Step S54, it shifts to Step S55.

[0064] At Step S55, an update process called reset, the display of before and an after page picture, the display of a receiving picture, and re-writing in the screen displayed now is performed according to the content of screen rewriting instructions. Reset is performed by writing for example, in a liquid crystal display element so that a screen may be painted out in the monochrome of black, white, or others. A picture [others' eyes] to make it touching, while the picture which became unnecessary [a display] by this was eliminated or it had been displayed is eliminable. Next, screen rewriting instructions are turned off at Step S56, and this sub routine is ended.

[0065] Drawing 16 shows the sub routine of the power-saving processing performed at Step S7. First, it judges whether the drive control section 56 is in an OFF state at Step S61, and if it is an OFF state, this sub routine will be ended immediately. If it is an ON state, the power supply of the drive control section 56 will be turned off for the timer for power saving counting up at Step S62 at waiting and Step S63, and the timer for power saving will be reset at Step S64. Thus, after rewriting becomes possible [specifically attaining power-saving by stopping the energization to the aforementioned booster circuit] by turning off the drive control section 56, continuing a display.

[0066] Moreover, a picture can be written in, shortly after display is in the standby state and there are instructions of a display until a predetermined time passes, since the drive control section 56 is turned off after predetermined-time progress (for example, after 5 minutes) from picture writing. Therefore, the operability in the case of writing in a picture after between short time is good.

[0067] (Refer to the 2nd operation form, drawing 17 - drawing 22) Drawing 17 shows the album type display unit 30 which is the 2nd operation form of this invention. This display unit 30 consists of display objects 33-38 of a cover 31 and 32 or 6 sheets of back covers, and the display screen from the 1st page to the 6th page is constituted in the front rear face of each display objects 33-38 by the liquid crystal display element 100 shown in drawing 20 . Each of these constructs are filed free [rotation] by two or more retaining rings 41 in each end section. A case 42 is installed in the interior of a retaining ring 41, and the control circuit shown in this case 42 at drawing 22 is held.

[0068] In more detail, as shown in drawing 18 and drawing 19 , each display objects 33-38 are attached in the connection 43 prepared in the retaining ring 41. A connection 43 consists of segments 43a and 43b carried out 2 ****s, the display objects 33-38 insert the edge in the level difference section of Segments 43a and 43b, and it is fixed by fitting a cap 44 into a vertical edge. Since Segments 43a and 43b will dissociate if a cap 44 is removed, each display objects 33-38 can be removed easily. Moreover, this connection 43 serves not only as the attachment-and-detachment function of each display objects 33-38 but as the function as a connector which connects the electrode 113,114 and control circuit of each liquid crystal display element 100.

[0069] By the way, the edge of the electrode 113,114 of the liquid crystal display element 100 will be exposed to each removed display objects 33-38. Therefore, it is desirable to prepare covering for protecting an electrode 113,114. It is thin, and since the display objects 33-38 have memory nature, they are removed from a main part and paper-like use is possible for them. If an electrode protective cover is formed with hard material, the accident which does not take the display objects 33-38 for the usual paper, and is supplied to a shredder can be prevented. Moreover, in consideration of paper-like use, you may print specific information at the marginal part (fields other than the display screen) of the liquid crystal display element 100.

[0070] About the liquid crystal display element 100 in which the picture was written like the above-mentioned, the display objects 33-38 are removed from a connection 43, and if it equips with a new display object, the picture of many sheets can be written in. In this way, if wearing, writing, and removal are repeated, two or more pictures can be acquired using one display unit 30. What is necessary is to arrange the display objects 33-38 which the picture was written in and removed in on support stands, such as easel, and just to place them. A big picture can be displayed if the big picture of one sheet is divided, written in and arranged in two or more liquid crystal display elements 100.

[0071] Moreover, in case the display objects 33-38 are removed from a connection 43, you may make it write additional information in the liquid crystal display element 100. For example, what is necessary is just to write the connection relation between a display position or a picture in the grade which does not spoil a display image at each element 100, if it divides into two or more liquid crystal display elements 100 and the large picture of one sheet is written in.

[0072] Or the time when the element 100 concerned was removed from the connection 43 can be grasped by displaying the write-in time of a picture. When the removed time is longer than a predetermined time, this image information may be reinputted by operation of a specific key etc., and a picture may be re-written in. In this case, driver voltage to the liquid crystal display element 100 is made high, or voltage impression time is set up for a long time, and you may make it change the drive method. Moreover, in the case of this reinput, once it resets a screen, you may also write in. Or you may establish a means to detect the temperature of the liquid crystal display element 100, and a means to change the drive methods (driver voltage, impression time, etc.) according to the detected temperature.

[0073] Drawing 20 shows the cross-section composition of the liquid crystal display element 100 used with the **** 2 operation gestalt. This liquid crystal display element 100 consists of the same composition as fundamentally as the liquid crystal display element (refer to drawing 5) shown with the aforementioned 1st operation gestalt. Therefore, the same sign as drawing 5 is given to the same member, and the explanation is omitted. Differing is in the point that an electrode 113,114 is connected removable to the connection terminal area 45, and the point which made the optical-absorption layer 121 thin.

[0074] Drawing 21 shows roughly the superficial array of the scanning electrode 113 and a signal electrode 114. The scanning electrode 113 has extended toward the output terminal 63 of the scanning drive IC 61 horizontally. A signal electrode 114 extends perpendicularly, is horizontally taken about at the vertical edge, and is made to face the output terminal 64 of the signal drive IC 62. Now, output terminals 63 and 64 and connection in the end section of the display objects 33-38 are possible for all the electrodes 113,114. In addition, the composition of such an electrode is the same also in the liquid crystal display element shown in drawing 5 .

[0075] Drawing 22 shows a control circuit. This control circuit consists of same composition as fundamentally as the control circuit (refer to drawing 8) of the aforementioned 1st operation gestalt, the same sign as drawing 8 is given to the same component, and the explanation is omitted. In addition, with this 2 operation gestalt, since each display objects 33-38 are removable, the sensor 71 for the wearing check is formed.

[0076] (others -- operation gestalt) in addition, the display unit concerning this invention is not limited to the aforementioned operation gestalt, within the limits of the summary, can be boiled variously and can be changed Especially the appearance of a display unit, the composition of a control unit, and the binding means of each display object are arbitrary. Moreover, about liquid crystal, the various cell composition and drive methods are employable.

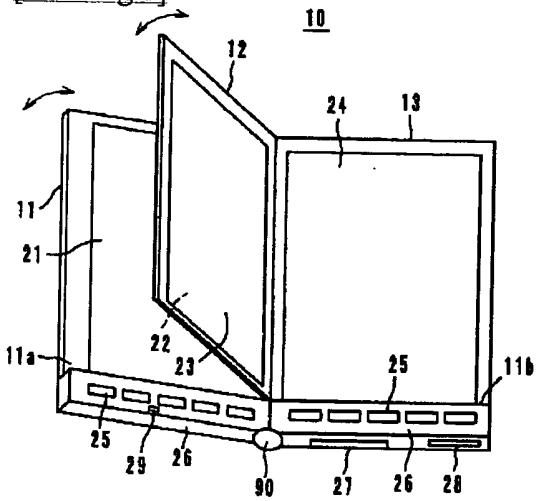
[Translation done.]

* NOTICES *

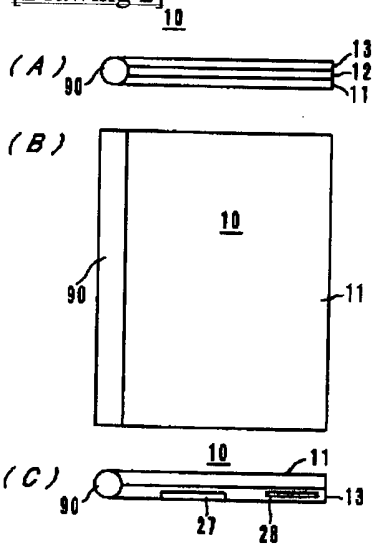
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

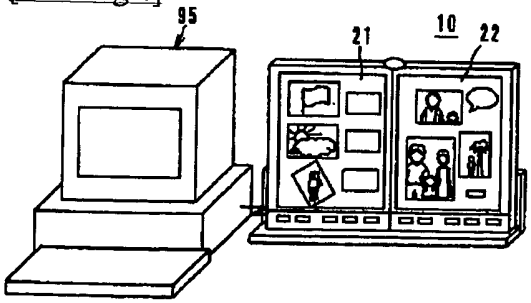
[Drawing 1]



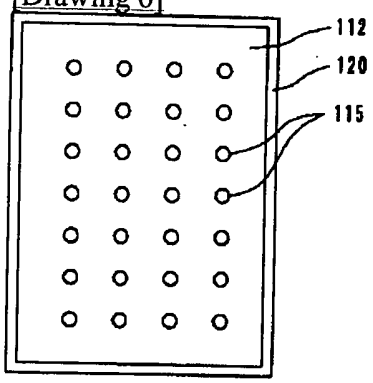
[Drawing 2]



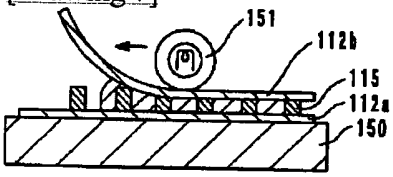
[Drawing 4]



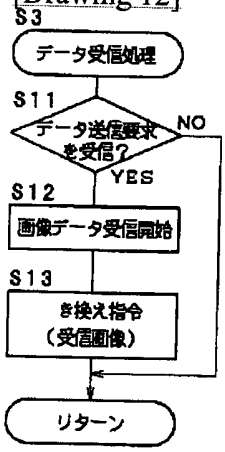
[Drawing 6]



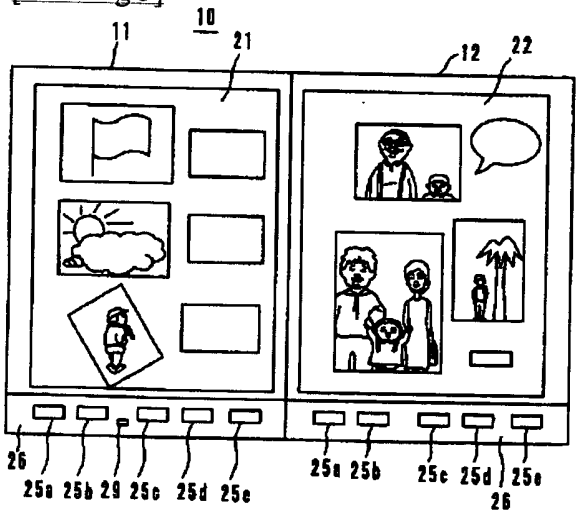
[Drawing 7]



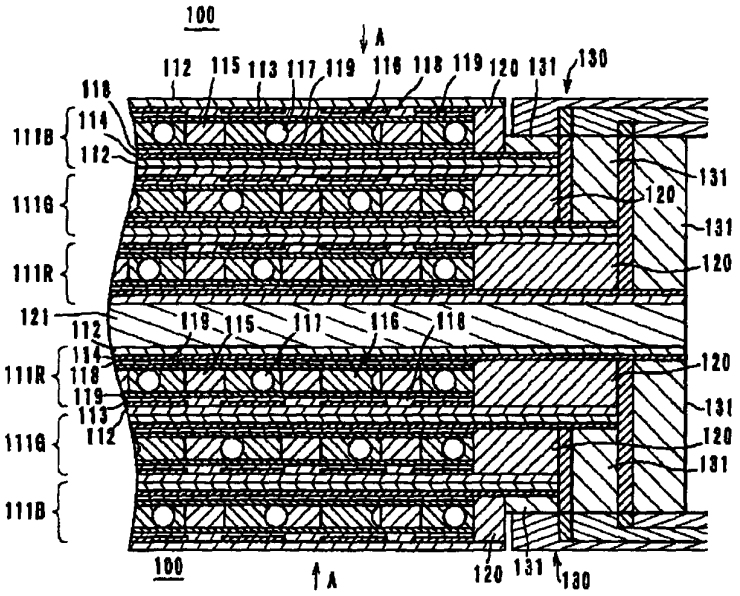
[Drawing 12]



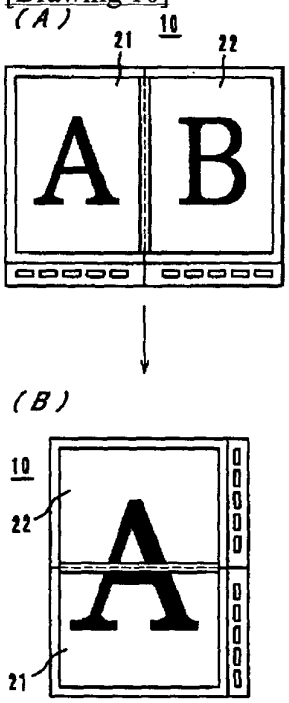
[Drawing 3]



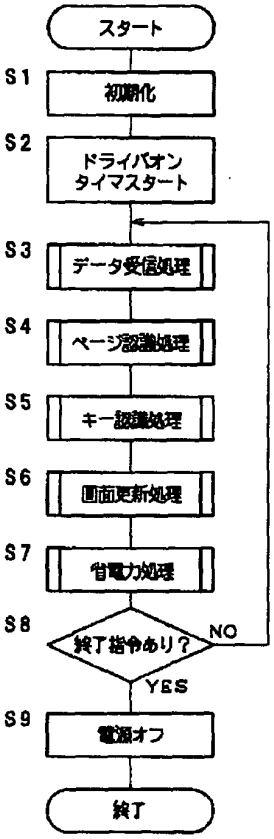
[Drawing 5]



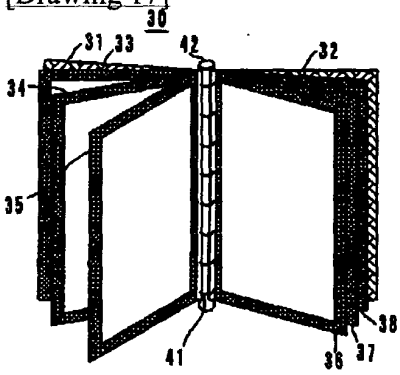
[Drawing 10]



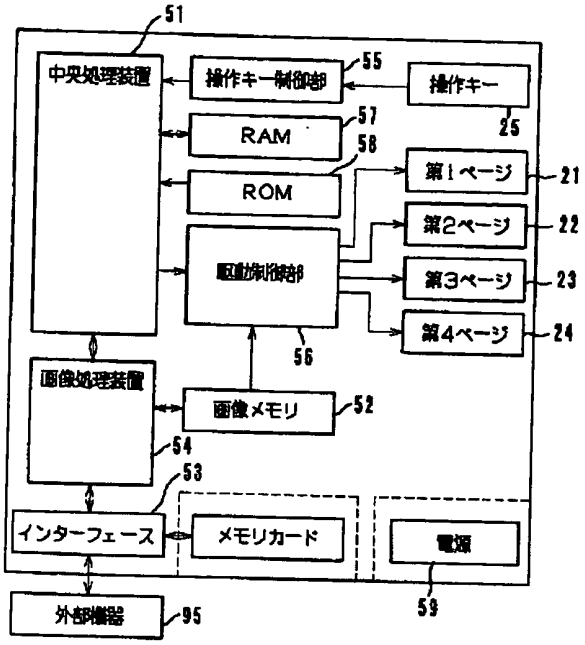
[Drawing 11]



[Drawing 17]



[Drawing 8]



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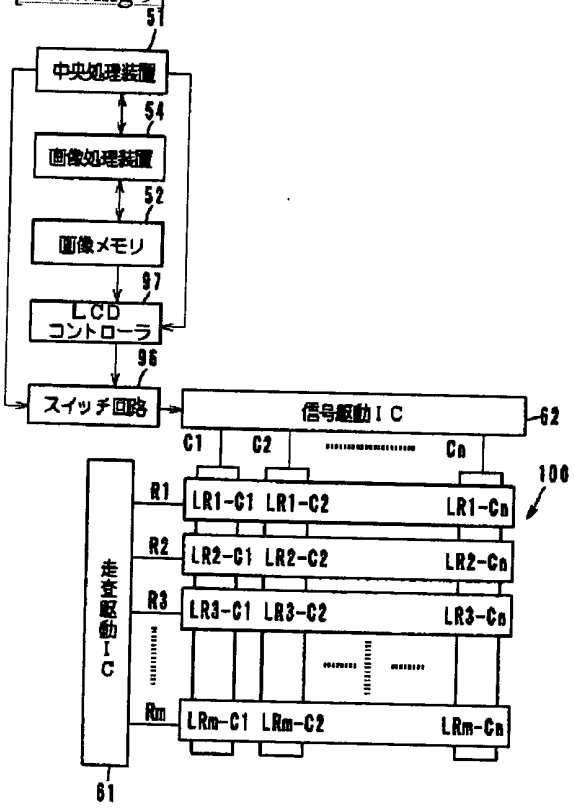
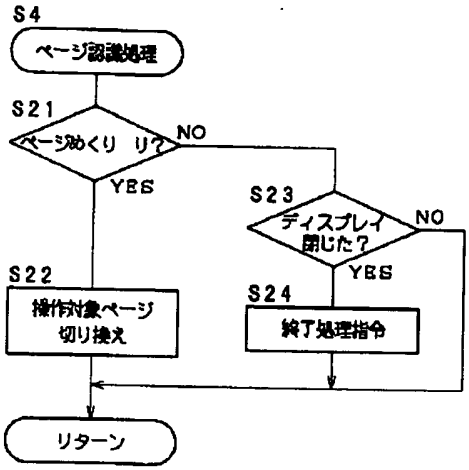
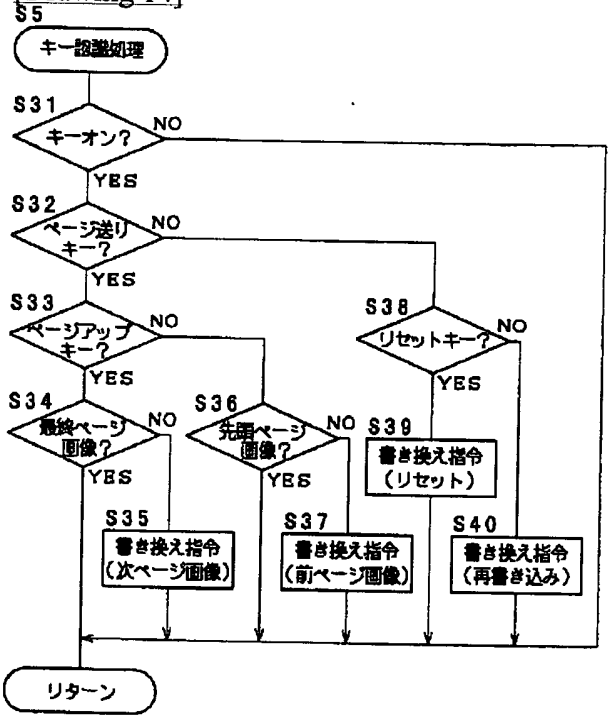


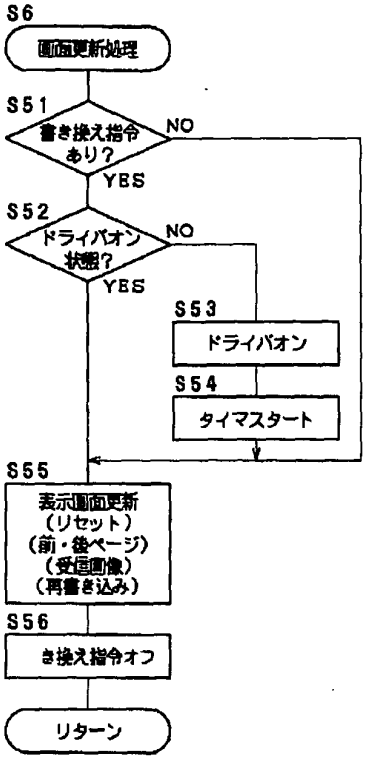
[Drawing 13]



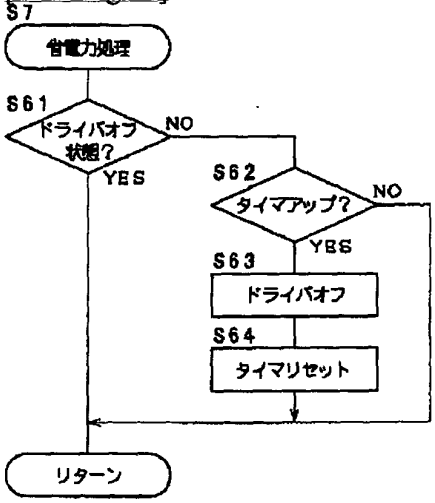
[Drawing 14]



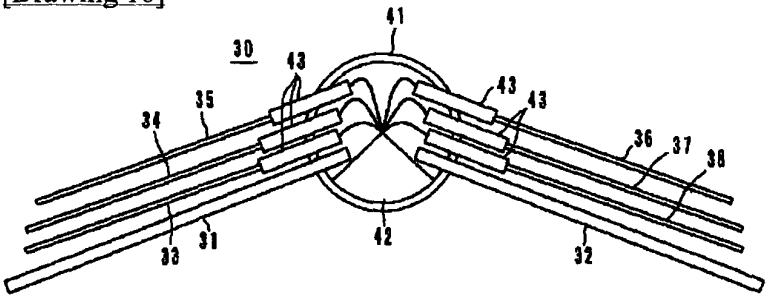
[Drawing 15]



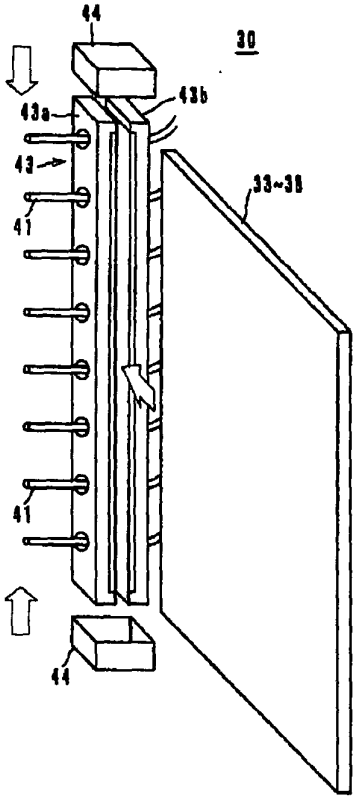
[Drawing 16]



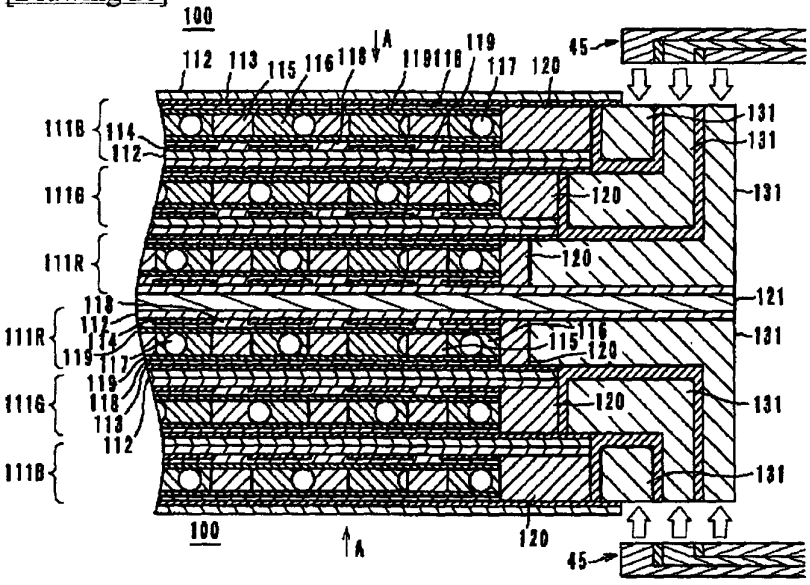
[Drawing 18]



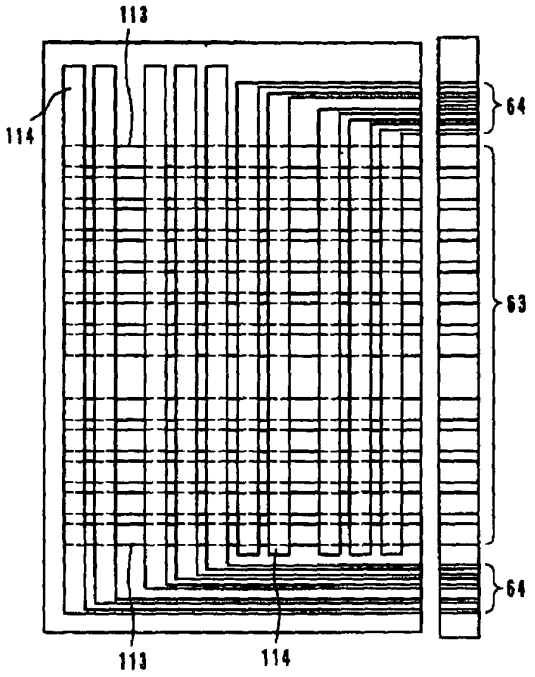
[Drawing 19]



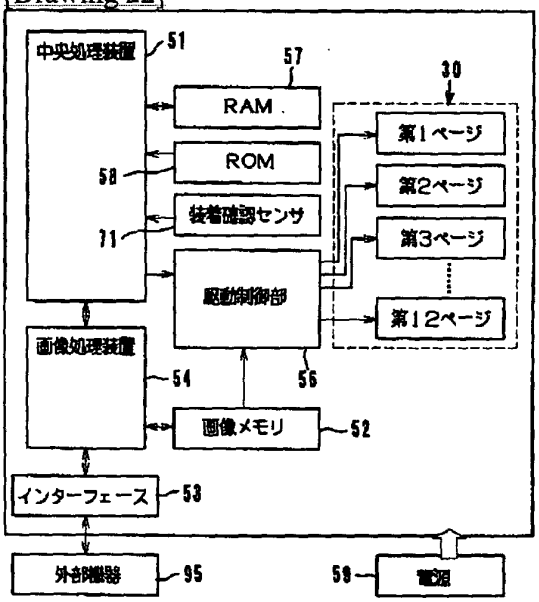
[Drawing 20]



[Drawing 21]



[Drawing 22]



[Translation done.]